JC08 Rec'd PCT/PTO 10 JAN 2002

FORM PTO-1390 (Modified) (REV 10-95) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER
1908

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR
10/030832

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE 00/02250	**JULY 11, 2000**	**JULY 15, 1999**

TITLE OF INVENTION
METHOD FOR DETECTING CHANGES OF SCENE, AND MONITORING SYSTEM THEREFOR

APPLICANT(S) FOR DO/EO/US
Michael MEYER, Michael HOETTER, Jens DREVES

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☐ A copy of the International Search Report (PCT/ISA/210).
8. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☐ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 13 to 18 below concern document(s) or information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
    A **SECOND** or **SUBSEQUENT** preliminary amendment.
16. ☐ A substitute specification.
17. ☐ A change of power of attorney and/or address letter.
18. ☒ Certificate of Mailing by Express Mail
19. ☐ Other items or information:

ET 755324124 US

531 Rec'd PCT/PTO 10 JAN 2002

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR) 10/030832	INTERNATIONAL APPLICATION NO. PCT/DE 00/02250	ATTORNEY'S DOCKET NUMBER 1908

20. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

		CALCULATIONS	PTO USE ONLY
☐ Search Report has been prepared by the EPO or JPO	**$930.00**		
☐ International preliminary examination fee paid to USPTO (37 CFR 1.482)	**$720.00**		
☐ No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2))	**$790.00**		
☒ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2) paid to USPTO	**$1,070.00**		
☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4)	**$98.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =		**$890.00**	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).		**$0.00**	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	12 - 20 =	0	x $18.00	**$0.00**	
Independent claims	2 - 3 =	0	x $80.00	**$0.00**	
Multiple Dependent Claims **(check if applicable).**			☐	**$0.00**	
	TOTAL OF ABOVE CALCULATIONS =			**$890.00**	
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) **(check if applicable).** ☐				**$0.00**	
	SUBTOTAL =			**$890.00**	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +				**$0.00**	
	TOTAL NATIONAL FEE =			**$890.00**	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).** ☐				**$0.00**	
	TOTAL FEES ENCLOSED =			**$890.00**	
				Amount to be: refunded	$
				charged	$

☐ A check in the amount of to cover the above fees is enclosed.

☒ Please charge my Deposit Account No. **19-4675** in the amount of **$890.00** to cover the above fees. A duplicate copy of this sheet is enclosed.

☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **19-4675** A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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SIGNATURE

MICHAEL J. STRIKER
NAME

27233
REGISTRATION NUMBER

JANUARY 10, 2002
DATE

10/030832

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UNITED STATES PATENT AND TRADEMARK OFFICE

Examiner: Group: Attorney Docket # 1908

Applicant(s) : MEYER, M., ET AL

Serial No. :

Filed :

For : METHOD FOR DETECTING CHANGES OF SCENE, AND MONITORING SYSTEM THEREFOR

SIMULTANEOUS AMENDMENT

January 10, 2002

Honorable Commissioner of Patents and Trademarks
Washington, D.C. 20231

S I R S:

Simultaneously with filing of the above identified application please amend the same as follows:

In the Claims:

Cancel all claims without prejudice.

Substitute the claims attached hereto.

REMARKS:

This Amendment is submitted simultaneously with filing of the above identified application.

With the present Amendment applicant has amended the claims so as to eliminate their multiple dependency.

Consideration and allowance of the present application is most respectfully requested.

Respectfully submitted,

Michael J. Striker
Attorney for Applicant(s)
Reg. No. 27233

Claims

1. A method for detecting changes in a viewfield that is observed by a stationary image capturing device (1), in which a reference image of the viewfield is compared to at least one current image of the viewfield, characterized in that based on the reference image and the current image, a reference edge image and an edge image are established (10, 11), that the correlation of at least one region of the edge image with the corresponding partial image of the reference edge image is determined (20, 21), and that when the correlation falls below a threshold, the region is identified as changed (70).

2. The method according to claim 1, characterized in that the correlation of the edge image with the reference edge image is determined (21) and that an alarm is output (110) when at least one region is detected as changed for a predetermined time (T1) longer than the edge image is detected as changed.

3. The method according to claim 2, characterized in that an alarm is output (110) when the at least one region of the edge image is detected as changed for longer than an additional predetermined time (T2), where the additional predetermined time (T2) is greater than the predetermined time (T1).

4. The method according to [one of the preceding claims] <u>claim 1</u>, characterized in that when the threshold is exceeded, the average quadratic deviation of the region of the edge image from the corresponding partial image of the reference edge image is determined (40), where a possible brightness difference between the reference edge image and the edge image is eliminated from the calculation so that by computing the image noise, a determination can be made as to whether there is a deviation of the region of the edge image from the partial image of the reference edge image that does not result from image noise and the brightness difference.

5. The method according to claim 4, characterized in that in the event that there is no deviation, the current image noise is computed and is stored for use in a subsequent image comparison.

6. The method according to [one of the preceding claims] <u>claim 1</u>, characterized in that the viewfield contains an object to be monitored.

7. The method according to claim 6, characterized in that the object is an exhibited object, in particular in a museum, or is an automated teller machine, where at least one region is constituted by the keypad field and/or the cash distribution slot and/or a card slot of the automated teller machine.

8. A monitoring system with a computer (2) for processing image data from a stationary image capturing device (1) that is aimed at a predetermined viewfield, characterized in that based on a reference image of the viewfield and a current image of the viewfield, the computer (2) establishes a reference edge image and an edge image, that the computer determines the correlation of at least one region of the edge image with the corresponding partial image of the reference edge image, and that when the correlation falls below a threshold, the computer registers the region as changed.

9. The monitoring system according to claim 8, characterized in that the computer determines the correlation of the edge image with the reference edge image, that the computer is connected to a signal indicator (5) so that an alarm is output via the signal indicator (5) when the at least one region is detected as changed for a predetermined time (T1) longer than the edge image is detected as changed.

10. The monitoring system according to claim 9, characterized in that an alarm is output via the signal indicator (5) when the at least one region of the edge image is detected as changed for longer than an additional predetermined time (T2), where the additional predetermined time (T2) is greater than the predetermined time (T1).

11. The monitoring system according to [one of claims 8 to 10] claim 8, characterized in that when the threshold is exceeded, the computer determines the difference of the region of the edge image from the corresponding partial image of the reference edge image, where a possible brightness difference between the reference edge image and the edge image is eliminated from the calculation so that by computing the image noise, a determination can be made as to whether there is a deviation of the region of the edge image from the partial image of the reference edge image that does not result from the image noise and the brightness difference.

12. The monitoring system according to [one of claims 8 to 11] claim 8, characterized in that the image capturing device is a video camera.

Claims

1. A method for detecting changes in a viewfield that is observed by a stationary image capturing device (1), in which a reference image of the viewfield is compared to at least one current image of the viewfield, characterized in that based on the reference image and the current image, a reference edge image and an edge image are established (10, 11), that the correlation of at least one region of the edge image with the corresponding partial image of the reference edge image is determined (20, 21), and that when the correlation falls below a threshold, the region is identified as changed (70).

2. The method according to claim 1, characterized in that the correlation of the edge image with the reference edge image is determined (21) and that an alarm is output (110) when at least one region is detected as changed for a predetermined time (T1) longer than the edge image is detected as changed.

3. The method according to claim 2, characterized in that an alarm is output (110) when the at least one region of the edge image is detected as changed for longer than an additional predetermined time (T2), where the additional predetermined time (T2) is greater than the predetermined time (T1).

4. The method according to claim 1, characterized in that when the threshold is exceeded, the average quadratic deviation of the region of the edge image from the corresponding partial image of the reference edge image is determined (40), where a possible brightness difference between the reference edge image and the edge image is eliminated from the calculation so that by computing the image noise, a determination can be made as to whether there is a deviation of the region of the edge image from the partial image of the reference edge image that does not result from image noise and the brightness difference.

5. The method according to claim 4, characterized in that in the event that there is no deviation, the current image noise is computed and is stored for use in a subsequent image comparison.

6. The method according to claim 1, characterized in that the viewfield contains an object to be monitored.

7. The method according to claim 6, characterized in that the object is an exhibited object, in particular in a museum, or is an automated teller machine, where at least one region is constituted by the keypad field and/or the cash distribution slot and/or a card slot of the automated teller machine.

8. A monitoring system with a computer (2) for processing image data from a stationary image capturing device (1) that is aimed at a predetermined viewfield, characterized in that based on a reference image of the viewfield and a current image of the viewfield, the computer (2) establishes a reference edge image and an edge image, that the computer determines the correlation of at least one region of the edge image with the corresponding partial image of the reference edge image, and that when the correlation falls below a threshold, the computer registers the region as changed.

9. The monitoring system according to claim 8, characterized in that the computer determines the correlation of the edge image with the reference edge image, that the computer is connected to a signal indicator (5) so that an alarm is output via the signal indicator (5) when the at least one region is detected as changed for a predetermined time (T1) longer than the edge image is detected as changed.

10. The monitoring system according to claim 9, characterized in that an alarm is output via the signal indicator (5) when the at least one region of the edge image is detected as changed for longer than an additional predetermined time (T2), where the additional predetermined time (T2) is greater than the predetermined time (T1).

11. The monitoring system according to claim 8, characterized in that when the threshold is exceeded, the computer determines the difference of the region of the edge image from the corresponding partial image of the reference edge image, where a possible brightness difference between the reference edge image and the edge image is eliminated from the calculation so that by computing the image noise, a determination can be made as to whether there is a deviation of the region of the edge image from the partial image of the reference edge image that does not result from the image noise and the brightness difference.

12. The monitoring system according to claim 8, characterized in that the image capturing device is a video camera.

Method for Detecting Changes of Scene, and Monitoring System Therefor

Prior Art

The invention is based on a method and a monitoring system as generically defined by the preamble to the independent claims. The publication "Gefahrenmeldesysteme, Technik und Strukturen" [Danger Alert Systems, Technology and Structures] by Harald Fuhrmann, Hüttig-Verlag, Heidelberg, 1992, ISBN 3-7785-2185-3, pp. 82 – 83, has already disclosed comparing a reference image of a viewfield with a current image so that changes in the current image in relation to the reference image cause an alarm to be triggered; in order to detect differences, a gray value comparison is executed.

Advantages of the Invention

The method and monitoring system according to the invention, with the characterizing features of the independent claims, have the advantage over the prior art that when people who remain in a predetermined scene for an unusual length of time are detected, when objects that are placed in a predetermined scene are detected, or when a theft of objects from a predetermined scene is detected, that is, when static changes in a predetermined viewfield are detected, then disturbance variables can be deliberately permitted. Because the image signal is not directly evaluated, i.e. the gray value or color value of the camera image, but rather the structure data contained in a camera image is evaluated; brightness changes and different illuminations of the scene are essentially not taken into account in the calculation of the detection result.

Advantageous modifications and improvements of the method and monitoring system disclosed in the independent claims are possible by means of the steps taken in the dependent claims. It is particularly advantageous to compare the chronological course of the change in a region of interest with the chronological course of a change in the overall

image so that long-term changes of the region can be reliably detected; the required time phases of the change can be predetermined as a function of the individual intended use. Temporary changes, such as the short-term obstruction of a camera by a person, an insect sitting on the lens of the monitoring camera, or the like, are thus reliably detected as such and do not cause the alarm to be triggered.

Taking into account an additional predetermined time assures that unusual blockages of the camera, such as its being covered by a cloth, can be distinguished from other changes in the scene in order to trigger an alarm.

The use of the average, quadratic deviation of current images turns out to be an advantageously simple possibility for executing a significance test while taking into account image noise and for simultaneously producing a feature for detecting changes, which is reliable in actual practice, so that those changes are also registered, which have not yet by themselves led to classification of the region as a changed region solely based on the correlation consideration. Another improvement of the significance test is achieved in that if there is no change in the scene, the threshold for the detection is adaptively tracked on a continuing basis by means of a measurement of the current image noise. This property on the one hand permits the use of different cameras for capturing images by virtue of the fact that properties of the camera that are important for the detection are automatically and therefore independently detected and measured; on the other hand, changes in the camera during operation, e.g. when there are different lighting conditions and equipment aging conditions, these changes are taken into consideration and correspondingly compensated for.

Drawings

Exemplary embodiments of the invention are shown in the drawings and will be explained in detail in the description that follows.

Fig. 1 shows a monitoring system,

Fig. 2 shows a flowchart,

Fig. 3 shows another flowchart, and

Fig. 4 shows a third flowchart.

Description of the Exemplary Embodiments

Fig. 1 shows a monitoring system with a camera 1, a computer 2, an input device 3, a storage device 4, a signal indicator 5, and a monitor 6; the camera 1, the input device 3, the storage device 4, the monitor 6, and the signal indicator 5 are connected to the computer 2 via connecting lines 7.

The camera 1 is aimed at a predetermined viewfield to be monitored. The stationary camera supplies image data to the computer 2, which executes a video-based detection of static scene changes, as described in Figs. 2, 3, and 4. The memory is used to store reference images so that the current image data can be compared to the stored reference image. The monitor 6 displays a picture of the viewfield captured by the camera 1. The signal indicator 5 indicates a static change of the scene in the viewfield, for example by means of an acoustic or optical warning signal. The signal indicator here can be integrated into the monitor, i.e. an optical display can take place in a partial region of the monitor; in addition, an alarm tone can be output by its speakers or by separately mounted speakers. The input device 3 is used to select regions of interest in the viewfield that are especially tested for static changes. Furthermore, the input device can be used to input times T1 and T2 which depending on the intended use, determine the duration of a change which should lead to the triggering of an alarm. In this connection, the longer time

T2 is used for the detection of unusually long changes, for example when the camera is covered or during long-duration manipulations of persons committing illegal acts in the viewfield. On the other hand, the time T1 is used to distinguish short-term changes in a large part of the viewfield from a change in a region of interest. The times T1 and T2 and the selection of the regions are also stored in the memory 4 in the same way as the reference image.

Fig. 2 shows a flowchart for the method sequence of the image processing. A stationary camera captures continuous images of a predetermined viewfield in which possible changes are to be detected. Before the system is placed into operation, a reference image of the scene is captured and stored in a memory. With continuous monitoring, the current images of the viewfield are compared to the reference image. To this end, in process step 11, the structure data are calculated for both the reference image and the current image by virtue of the fact that the gradient of the brightness value and/or the color value in the horizontal direction and vertical direction of the two-dimensional pictures are detected and along with them, the edge data or the data relating to jumps in the gray value or color value in the viewfield. Then in process step 21, the correlation of the gradients, which are referred to below as edge images, is calculated from the current image and the reference image. In this connection, a correlation coefficient r is calculated according to the Bronstein-Semendjajew "Taschenbuch der Mathematik" [Pocket Edition of Mathematics], Verlag Harri Deutsch, Thun, 24th edition, 1989, formula (5.92), p. 692:

$$r = (\Sigma\, (xn - \underline{x})\, (yn - \underline{y}))\ /\ \sqrt{(\Sigma\, (xn - \underline{x})^2\ \Sigma\, (yn - \underline{y})^2)}.$$

In this equation, xn is the gradient at the position n in the reference image, yn is the gradient at the position n in the current image, $\underline{x}$ is the average of the gradients in the reference image, $\underline{y}$ is the average of the gradients in the current image, and n is the numbering index of the image positions which is expressed in natural numbers, for example. The summations are executed via the gradients xn and yn in both spatial dimensions of the regions to be evaluated. The correlation coefficient has a value range

from –1 to 1. The value 1 here indicates the existence of an identical structure, the value 0 indicates that no correlation exists, i.e. a total change of the current image in comparison to the reference image. A value < 0 indicates an inverse proportion and is likewise to be taken as a total change. In step 26, the correlation value thus determined is compared to a threshold S3 (e.g. S3 = 0.3). If the correlation value is greater than the threshold, then in step 81, the image is judged to be unchanged (B = 0). Otherwise, the image is identified as changed in relation to the reference image (step 71, B = 1).

In this evaluation, the image signal is not tested directly, but the structure data calculated from the image is tested for similarity. By using correlation of the structural features, changes between the reference image and the current image which are caused by image brightness and contrast can be taken into account, i.e. even when the two images differ in these parameters, but have similar structures at identical image positions, the evaluation of the correlation results in a large similarity measurement.

Before the monitoring is started, regions of interest are established in the viewfield to be monitored. These parts of the image, which are referred to below as regions, as well as the overall image, are subjected to a correlation consideration each time the new image is processed. To this end, in process step 10, the edge image belonging to the region is separated from the edge image obtained to in the process step 11 of Fig. 2 and in process step 20, the correlation value of the regional edge image with the corresponding partial image of the edge image of the reference image is calculated. In step 25, the correlation value of the region under consideration is compared to a threshold S1 (e.g. S = 0.5). If the correlation value lies below this threshold, then in step 70, the relevant region i is detected as changed (R (i) = 1). By contrast, if the correlation value exceeds the threshold S1, then the similarity of the region to the corresponding partial region of the reference image is tested further. To this end, in process step 30, the change in image brightness and image contrast of the region in the current image in comparison to the reference image is calculated. Then in process step 40, the structural deviation is calculated. The average quadratic deviation of the edge image of the current image from

the edge image of the reference image in the region is determined pixel by pixel. The resulting numerical value is then corrected with regard to image brightness and image contrast. In a statistical significance test 45, a check is made as to whether the remaining change was caused by image noise. In this connection, a numerical value is established which evaluates the change in comparison to image noise. A numerical value of 1 here signifies that the change corresponds precisely to what is to be expected due to image noise. A numerical value of > 1 signifies that the change greater that what is to be expected due to image noise. The determined numerical value is compared to a threshold S2 (e.g. $S2 = 5$). If the numerical value is greater than the threshold S2, then the region is identified as changed (process step 70). Otherwise, no change is detected (process step 80): $R(i) = 0$. Before step 80 in this case, the image noise in the region is computed again (process step 60) in order to be able to use a current computation in chronologically subsequent evaluations. In this case, a value for the image noise is measured in the region identified as unchanged. The value to be used in a subsequent significance test is determined in a recursive filter: $A(t+1) = RE * A(t) + (1-RE) * B(t)$. In this equation, $A(t)$ is the assumed value of the image noise at time t, which was used in the significance test, $A(t+1)$ is the assumed value of the image noise at time t+1, which should be used as a new computed value for the next image, $B(t)$ is the value of the image noise measured at time t; RE is a recursion factor ($0<RE<1$), e.g. $RE = 0.9$. The value $A(0)$ at the beginning of the monitoring process is a heuristically selected initial value.

The region-oriented structure data analysis described in Fig. 3 is executed for each region selected at the start of the monitoring process and thus for each selected region, supplies the binary status datum “region changed” or “region unchanged”. The process steps 30, 40, 45, and 60 assure a reliable identification of changes even if a global structural comparison essentially independent of brightness fluctuations has not yet led to the identification of a change. The values for B and R (i) are supplied to the subsequent evaluation (see Fig. 4) for the alarm triggering.

Fig. 4 shows a method sequence for evaluating the data obtained in the sequences according to Figs. 2 and 3. To this end, for each region R (i), a test is made as to whether the value = 1 (step 91); if the answer is no, then a counter N (i) is set to zero (process step 93). A counter T (i) is also set to zero. If the answer is yes, then the counter N (i), which has the value 0 at the start of the process, is increased by 1 (process step 92). After process step 92, a test is made as to whether B = 1 (process step 94). If B = 1, then the counter T (i) is increased by 1 (process step 95). The counter T (i) in this instance is at 0 at the beginning of the process. In the negative case, after process step 94, after process step 95, and after process step 93, a query is made (query 96) as to whether N (i) is greater than T (i) + T1 or whether N (i) is greater than T2. If not, then no alarm is triggered. If yes, N (i) and T (i) are set to zero and an alarm 110 is triggered.

The aim of the above-described evaluation process is on the one hand, to detect changes in regions as early as possible but on the other hand, to permit global changes in the viewfield for greater time intervals. To that end, two time thresholds T1 and T2 are used. T2 here stands for the maximal time interval for which it is permissible for a region to be changed without an alarm being triggered. For example, T2 equals 15 minutes. T1 stands for the earliest time after which an alarm can be triggered with regard to a region, namely precisely when the overall image has been continuously identified as unchanged during this time. To this end, two counters per region are used: N (i) for indicating how often in direct chronological sequence a region has been identified as changed and T (i) for indicating the time at which a region was identified as "region changed" for the case in which the identification "overall image changed" has been made. By taking into account times in which the overall image has changed, changes which relate not only to the region, but also to the overall image do not result in the triggering of an alarm, unless the overall image has changed over a related time interval with the length T2 (in this regard, compare T2 = 15 min, which is selected to be greater than T1 at 20 sec., for example).

Claims

1. A method for detecting changes in a viewfield that is observed by a stationary image capturing device (1), in which a reference image of the viewfield is compared to at least one current image of the viewfield, characterized in that based on the reference image and the current image, a reference edge image and an edge image are established (10, 11), that the correlation of at least one region of the edge image with the corresponding partial image of the reference edge image is determined (20, 21), and that when the correlation falls below a threshold, the region is identified as changed (70).

2. The method according to claim 1, characterized in that the correlation of the edge image with the reference edge image is determined (21) and that an alarm is output (110) when at least one region is detected as changed for a predetermined time (T1) longer than the edge image is detected as changed.

3. The method according to claim 2, characterized in that an alarm is output (110) when the at least one region of the edge image is detected as changed for longer than an additional predetermined time (T2), where the additional predetermined time (T2) is greater than the predetermined time (T1).

4. The method according to one of the preceding claims, characterized in that when the threshold is exceeded, the average quadratic deviation of the region of the edge image from the corresponding partial image of the reference edge image is determined (40), where a possible brightness difference between the reference edge image and the edge image is eliminated from the calculation so that by computing the image noise, a determination can be made as to whether there is a deviation of the region of the edge image from the partial image of the reference edge image that does not result from image noise and the brightness difference.

5. The method according to claim 4, characterized in that in the event that there is no deviation, the current image noise is computed and is stored for use in a subsequent image comparison.

6. The method according to one of the preceding claims, characterized in that the viewfield contains an object to be monitored.

7. The method according to claim 6, characterized in that the object is an exhibited object, in particular in a museum, or is an automated teller machine, where at least one region is constituted by the keypad field and/or the cash distribution slot and/or a card slot of the automated teller machine.

8. A monitoring system with a computer (2) for processing image data from a stationary image capturing device (1) that is aimed at a predetermined viewfield, characterized in that based on a reference image of the viewfield and a current image of the viewfield, the computer (2) establishes a reference edge image and an edge image, that the computer determines the correlation of at least one region of the edge image with the corresponding partial image of the reference edge image, and that when the correlation falls below a threshold, the computer registers the region as changed.

9. The monitoring system according to claim 8, characterized in that the computer determines the correlation of the edge image with the reference edge image, that the computer is connected to a signal indicator (5) so that an alarm is output via the signal indicator (5) when the at least one region is detected as changed for a predetermined time (T1) longer than the edge image is detected as changed.

10. The monitoring system according to claim 9, characterized in that an alarm is output via the signal indicator (5) when the at least one region of the edge image is detected as changed for longer than an additional predetermined time (T2), where the additional predetermined time (T2) is greater than the predetermined time (T1).

11. The monitoring system according to one of claims 8 to 10, characterized in that when the threshold is exceeded, the computer determines the difference of the region of the edge image from the corresponding partial image of the reference edge image, where a possible brightness difference between the reference edge image and the edge image is eliminated from the calculation so that by computing the image noise, a determination can be made as to whether there is a deviation of the region of the edge image from the partial image of the reference edge image that does not result from the image noise and the brightness difference.

12. The monitoring system according to one of claims 8 to 11, characterized in that the image capturing device is a video camera.

Abstract

A method for detecting changes in a viewfield observed by a stationary image capturing device is proposed, in which edge images are calculated and are compared to edge images of reference recordings in order to detect static changes within the observed image range that are independent of image brightness.

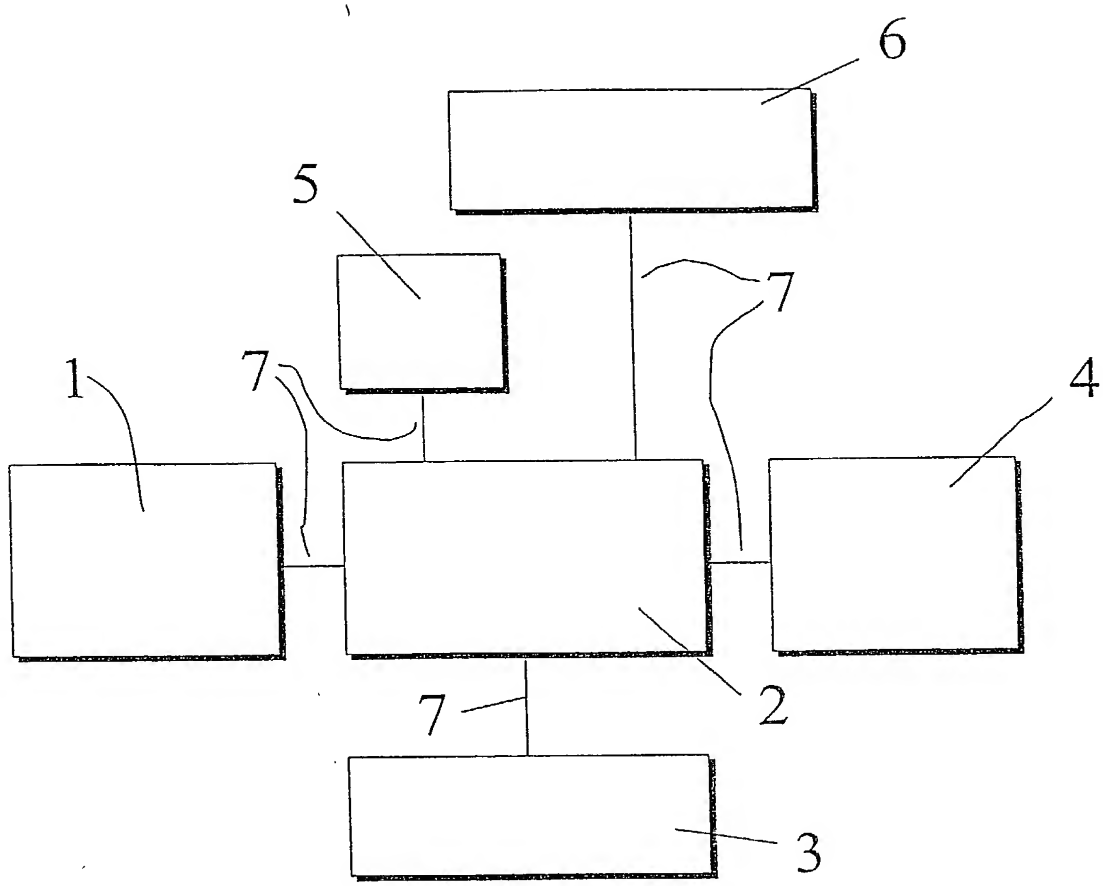

Fig.1

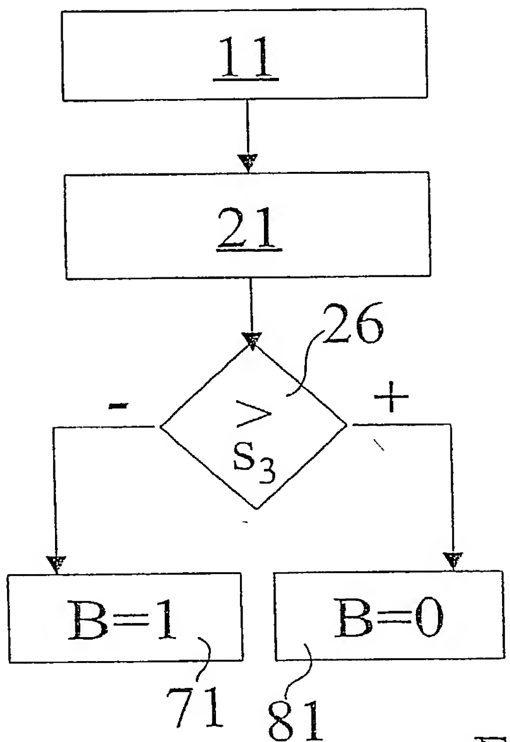

Fig.2

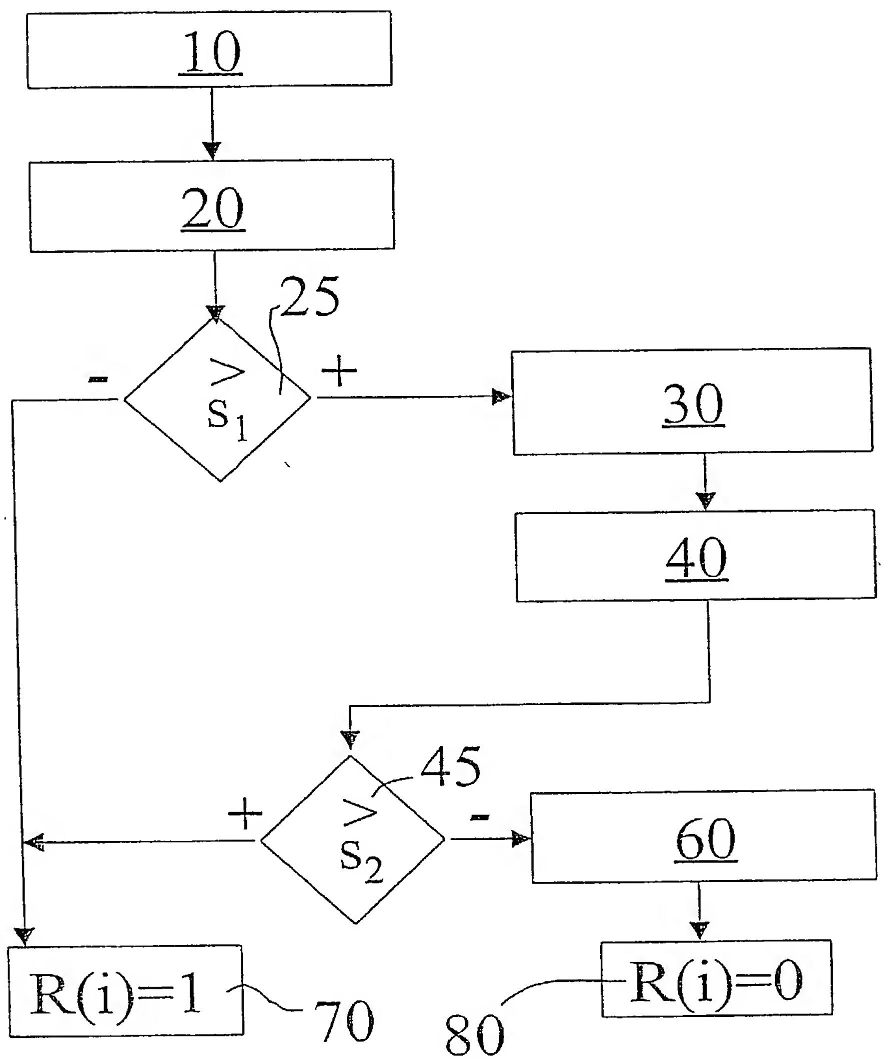

Fig. 3

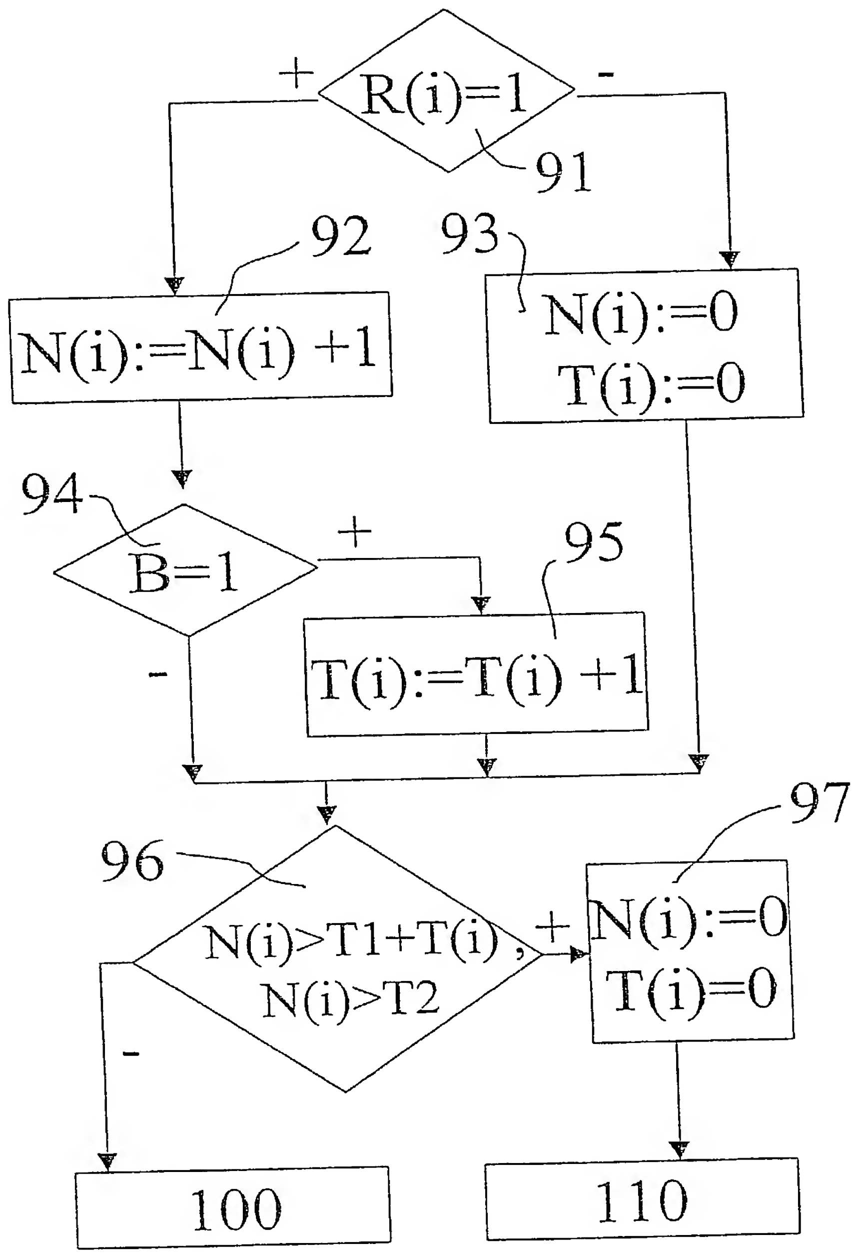
R(i)=1
+
-
91
92
93
N(i):=N(i) +1
N(i):=0
T(i):=0
94
B=1
+
95
-
T(i):=T(i) +1
97
96
N(i)>T1+T(i),
N(i)>T2
+
N(i):=0
T(i)=0
-
100
110

Fig.4

10031932 .041102

DECLARATION AND POWER OF ATTORNEY FOR NATIONAL STAGE OF PCT PATENT APPLICATION

As a below-named inventor, I hereby declare that:

Michael MEYER
Michael HOETTER
Jens DREVES

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled **METHOD FOR DETECTING CHANGES OF SCENE, AND MONITORING SYSTEM THEREFOR** the specification of which was filed as PCT International Application number PCT/DE 00/02250 on July 11, 2000.

I hereby state that I believe the named inventor or inventors in this Declaration to be the original and first inventor or inventors of the subject matter which is claimed and for which a patent is sought.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose all information which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365 (b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed.

Prior foreign application(s):			Priority claimed:	
199 32 662.2	GERMANY	JULY 15, 1999	X	
(Number)	(Country)	(Date filed)	Yes	No
(Number)	(Country)	(Date filed)	Yes	No

As a named inventor, I hereby appoint the following attorney to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment,

or both, under Section 1001 of Title 18 of the United States Code and that such wilful false statement may jeopardize the validity of the application or any patent issued thereon.

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